NYU FRE Department
FRE-GY 6901: Volatility Models
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PRE-REQUISITES

Prerequisites: stochastic calculus and option pricing

COURSE OBJECTIVES

Volatility is the crucial factor in determining the pricing and hedging of derivatives in finance and in quantifying and managing financial risks. It is therefore very important to be familiar with the different notions and products of volatilities and to accurately model the volatility of financial markets in order to (1) correctly evaluate and hedge derivative products, (2) generate realistic future scenarios in order to quantify and manage risks, and (3) predict future volatility.

At the end of the module, students will know the most important volatility models, the reasons why they were introduced, their properties, their advantages and flaws, and how to calibrate them to market data. They will also have implemented several models in Python (pricing, calibration).

In professional life, this module will allow students to correctly choose a volatility model depending on the problem at hand and how to calibrate it to market data.

COURSE PROGRAM

- The different types of volatility
- The different types of volatility derivatives
- The volatility smile
- Volatility modeling: a brief history
- Static v. dynamic properties of volatility models
- Black-Scholes
- Local volatility
- Stochastic volatility
- Variance curve models (second generation of stochastic volatility models)
- The smile of variance curve models
- Local stochastic volatility
- The particle method for smile calibration
- Rough volatility and path-dependent volatility

MODALITIES

7 sessions of 2h40min that mix lectures and exercises.

COURSE ASSESSMENT AND VALIDATION REQUIREMENTS FOR STUDENTS

Class participation: 10%
Homeworks and computing assignments: 60%
In-class final exam: 30%

Bibliography and course documents

Lecture slides. References:
- Bergomi, L.: Stochastic Volatility Modeling, Chapman & Hall, 2016.
- Gatheral, J.: The Volatility Surface, A Practitioner's Guide, Wiley Finance, 2006.
- Guyon, J. and Henry-Labordère, P.: Nonlinear Option Pricing, Chapman & Hall, 2014.